THE FIRST-YEAR SCIENCE COURSE IN HIGH SCHOOL.[1]

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Five years have elapsed since I was actually engaged in teaching physiography in high school, but during these years there have been several occasions upon which I have been forcibly reminded of my work in the high school and led to consider very seriously what was the real good of my teaching that subject to those young people. I have had several students come to me in the University courses whom I had taken through a year's work in physiography while they were in high school. It has been notably true that these students have not retained much of the data which had been presented in the classroom. This has not really surprised me, and I suspect that many teachers have had similar experiences in educational work. Nor has it at all discouraged me; for retaining in memory facts regarding one science or another is not of prime importance to the student entering upon his first year of scientific work. If my work in the high school was worth anything, it was in training those students with whom I came in contact in a more effective use of the scientific method of thought. The facts which I presented were but the tools in the educational process. Whenever I guided, persuaded, forced, or enticed a mind to think, to pass from one point on to another with the assurance that each new move made was correct because it rested on facts and valid deductions, I believe I did that mind some good.

All minds enjoy thinking, just as much as the athlete's

[1] Opening remarks at the Physiography and Biology Departmental Conference of Academies and Secondary Schools in Relations with the University of Chicago, November 12, 1910. The subject for discussion was, "The Relative Claims of Physiography, General Science, and General Geography for a Place in the First-Year High-School Curriculum."

muscles enjoy exercise or as our palates enjoy the sensation which comes from certain foods. The mind was made for thinking, and it enjoys that activity. The greatest danger in our educational work is that we stop the mind from thinking; we inhibit that process; we discourage it. Fully one-half of the students who come to us here at the University have almost lost the ability to think. Their mental machinery has become rusty, and it is only by the most strenuous methods that we can get that machinery into working order again. Years of mechanically learning and reciting what is in a book has discouraged thinking, has really taught the pupils not to think. This process of education has taught the young people to believe that what they may be expected to learn is in some book, that what they may be expected to do is explained in some book or will be explained to them. It has stopped all independence in the intellectual processes.

I believe, therefore, that any science course which would claim a place in the first year of the high-school curriculum should offer abundant opportunities for training young people to organize their knowledge, to acquire new facts, perfect their organization of facts in the light of new facts obtained, frame hypotheses, test these hypotheses, and ultimately come to a conclusion which is consistent with all known facts: in short, to acquire the scientific method of thought.

As little children all of us were research students. We were true investigators. Everything attracted attention, and there is no doubt that we were anxious to know about everything that we saw. That spirit of investigation is the spirit of true research, manifested in the most advanced intellectual work that the world knows of, and it is the duty of teachers in all lines of work to conserve with the greatest care that spirit of investigation. It is, furthermore, the duty of all teachers to train, in so far as they can, that instinctive desire to investigate, so that each year investigation may be carried on to a greater advantage. Some work can be taken up with young people in just that spirit of original investigation from the first day that the teacher meets the class; and I believe that any

course in science which would claim a place in the curriculum of the first year of high school should be of such a nature as to lend itself easily and happily to the preservation, training, and development of that spirit of research which is in all young people.

If the question is asked, what there is in physiography which makes it especially fitted for carrying on such educational work as I have held up as an ideal, we may answer that the facts worked with are in large part drawn from the experiences which the children have had, either in school work, in their out-of-door play, or in travel. Facts which are necessary in this work and which cannot be drawn from the experiences of the children may be readily obtained. They do not involve much technical knowledge. The reading is relatively simple. Pictures, lantern slides, drawings, museum material, simple laboratory experiments, and field excursions—all facilitate the process of gathering the necessary facts.

Again, the science is a broad one. It is not too highly specialized. The students are led from little observations which they have made to broader and broader conceptions of geologic processes which are world-wide. Such conceptions grow as contributions are received from the different members of the class, until the subject is rounded out with the unity consistent with that stage in the development of the child.

The fact that physiography as a science has been so well organized gives it a strong claim to a position in the first-year high-school curriculum. The organization of the facts by the student is easily guided by an expert teacher properly prepared in the subject-matter. The organization may not always be the same; it may not be the same in two classes at work on the same subject on the same day. The process of organizing the material, however, has the same educational advantage to the child. As the work goes on, it is clear—or at least it should be clear—to the children that they are making progress through these mental processes, through thinking, through organization of the known facts. They are gaining ground. They actually understand something which they did not for-

merly understand. This is a new way to many of them to reach desired ends.

Mr. Dewey in one of his essays emphasized the changing phases in attention which come with the normal development of the child. In very little children the attention is spontaneous, and immediate objects before them hold their attention. There is no conscious effort on the part of the child. Later the child will give attention because of some desired end or result which he wishes to attain. This phase of attention is sometimes spoken of as "voluntary." The transition to this voluntary attention comes slowly. To quote from Mr. Dewey:

> The child directs a series of individual activities on the basis of some end he wishes to reach. This end is something to be done or made or some tangible result to be reached; the problem is a practical difficulty rather than an intellectual question. But with growing power the child can conceive of the end as something to be found out, discovered, and can control his acts and images so as to help in the inquiry and solution. This is reflective attention proper.

Further on in the same article Mr. Dewey emphasizes the serious problem associated with the proper recognition of this incipient form of reflective attention, and urges most strongly the importance of taking every opportunity to train and develop this type of attention:

> A person who has gained the power of reflective attention, the power to hold problems, questions, before the mind, is in so far, intellectually speaking, educated. He has mental discipline, the power of the mind and for the mind. Without this the mind remains at the mercy of custom and external suggestions.[2]

This psychological analysis of attention has emphasized to me the importance of choosing such material for the first-year science course as will present numerous problems which the child at that stage in his development can undertake to solve, and which, furthermore, follow one after another, becoming more and more difficult, and leading to more and more significant conclusions.

I appreciate that one may select from all the sciences many

[2] *Elementary School Record*, Vol. I, No. 4 (1900), pp. 111-13.

interesting phenomena, and it is undoubtedly true that such selection provides material which in itself appeals to the child in the first year of high school as exceedingly interesting. I would raise the question whether this commands more than that childlike, spontaneous attention. Is it not using those things which, like the catastrophe or any spectacular phenomenon of nature, arouse spontaneous attention in all people? I recall a course in "general science" which was urged by a colleague of mine, which began with the study of the alarm clock which awoke the child in the morning. In a few moments the telephone bell rang, and that was the next thing to study. On the way to school, trolley cars, steam engines, automobiles were seen. Thus there was a chain of experiences which the child had each day which should form the basis of the scientific work in the first year of high school. There is an abundance of most interesting material for study suggested by just such experiences; but can such general science be made the means of attaining the highest ideals in educational work with those young people?

I appreciate also that the humanistic phases of general geography are exceedingly interesting. They are fascinating. And with the development of geography as a science it is quite possible that an elementary course may some day be selected and arranged which will prove to be exceedingly valuable for the first year in high school. But as yet general geography has not reached that stage of development. It is not a science.

In conclusion, I will therefore urge that this problem will not be solved until we understand the development of the child well enough to know what training is appropriate for each stage and know enough to select the proper material and to conduct the work in such a way as to reach the desired end. It is not a question as to which science shall be taught. The question is as to what influence we wish to produce. I have, therefore, aimed to present an educational ideal, and to indicate certain tests that may be applied whenever a new applicant for a position in the science curriculum appears.